Physics 4460/5460 Week 6
– Attitudes & Expectations!

Day 11:

CLASS - part 1

Open Source Tutorials - part 2

Learning Goals:

Ability to apply findings of CLASS pre/post shifts:

- measure outcomes
- correlations with key variables

(conceptual mastery, gender, retention …)

Ability to enact Open Source Tutorials,

describe and apply key principles

Quote of the day:
I wonder if research has been conducted on the balance between "thinking" vs "content."

Attitudes and Beliefs

Assessing the "hidden curriculum" - beliefs about physics and learning physics

Examples:

- "I study physics to learn knowledge that will be useful in life."
- "To learn physics, I only need to memorize solutions to sample problems"

Adams et al, (2006). Physical Review: Spec. Topics: PER, 0201010

CLASS categories

	Shift (%) ("reformed" class)	
Real world connect...	-6	
Personal interest.....	-8	Engineers: -12
Sense making/effort...	-12	
Conceptual.....	-11	
Math understanding...	-10	
Problem Solving.....	-7	
Confidence.....	-17	Phys Male: +1 Phys Female: -16
Nature of science.....	+5	

(All ±2%)

PHYSICAL REVIEW SPE ... CH 11, 010115 (2015)

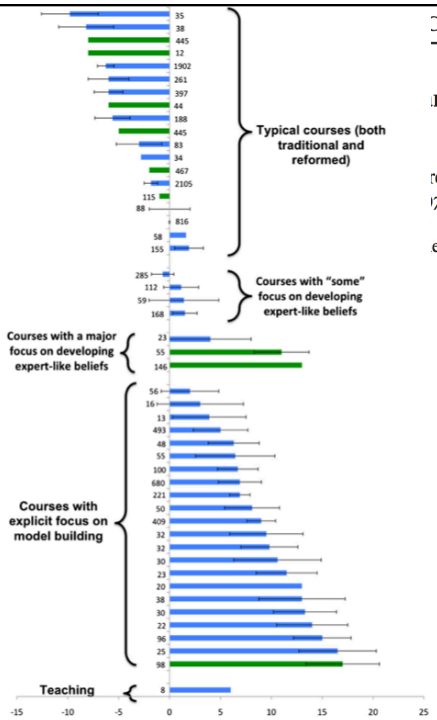
How physics inst ... rning physics:

Adria[1] ... re[2]

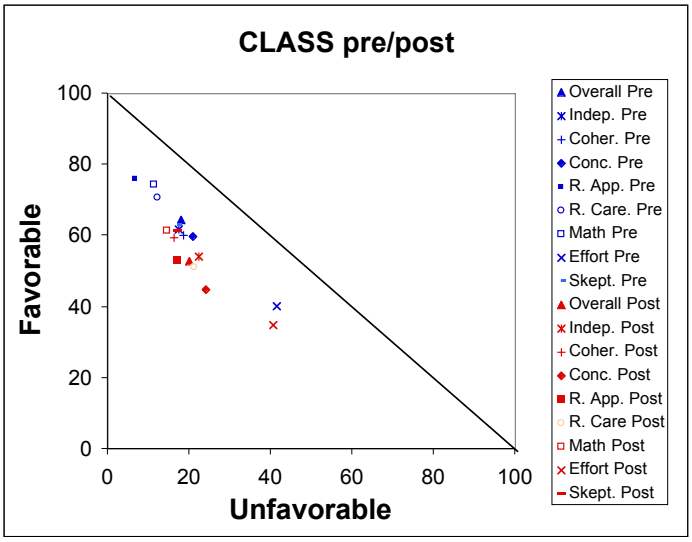
[1]American As ... 740, USA

[2]K ...

(Received 21 March ... ed 2 June 2015)

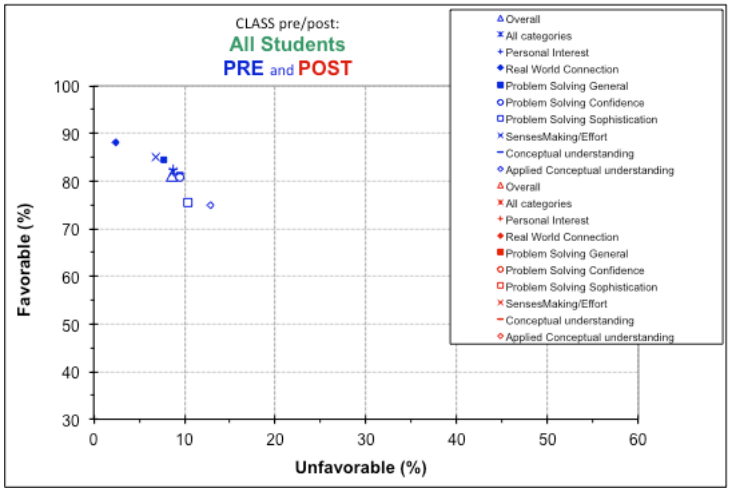


(Typical) Shifts



W. Adams 2003, replicating Redish, Steinberg, Saul AJP 66 p. 212 (‘98)

YOU



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Why does this matter?

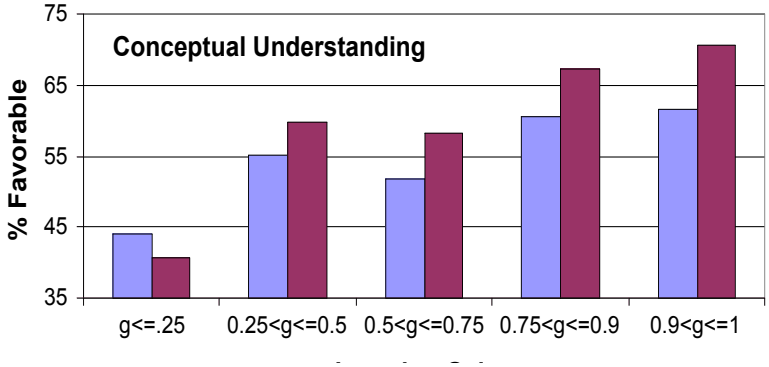
- Important in itself (our goals)
- Correlations among students' beliefs and . . .
  - Performance?
  - Worth of studying physics?
  - Gender?
  - Likelihood of staying in a course / major?
- Which is cause? effect? Or are they just coincident?
- Handout data for analysis…

4 Groupings

- Dataset #1: conceptual understanding
- Dataset #2: course / major (and distribution)
- Dataset #3: gender and course/major
- Dataset #4: "splits" - what you think, vs what a physicist would think.

Dataset #1

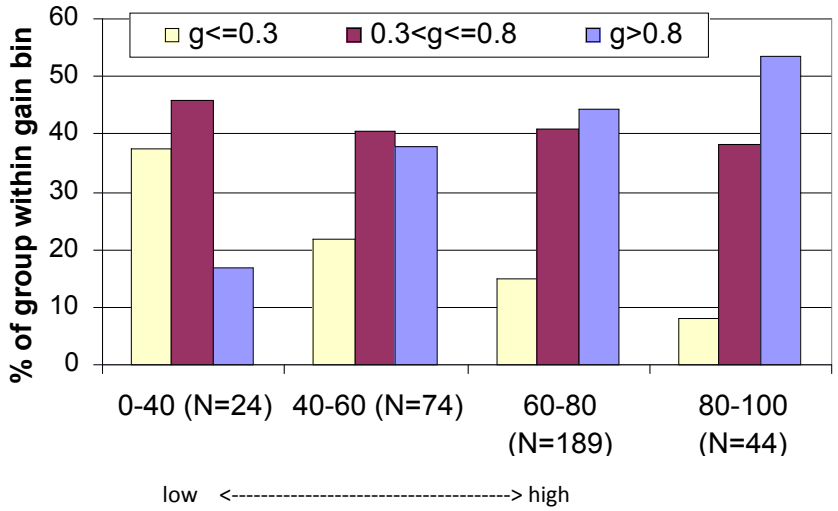
Data from instructor attending (somewhat) to "hidden curriculum")



Low learning gain <---------> high learning gain

Blue= **pre** Red= **post**

Dataset #1b



low <----------> high

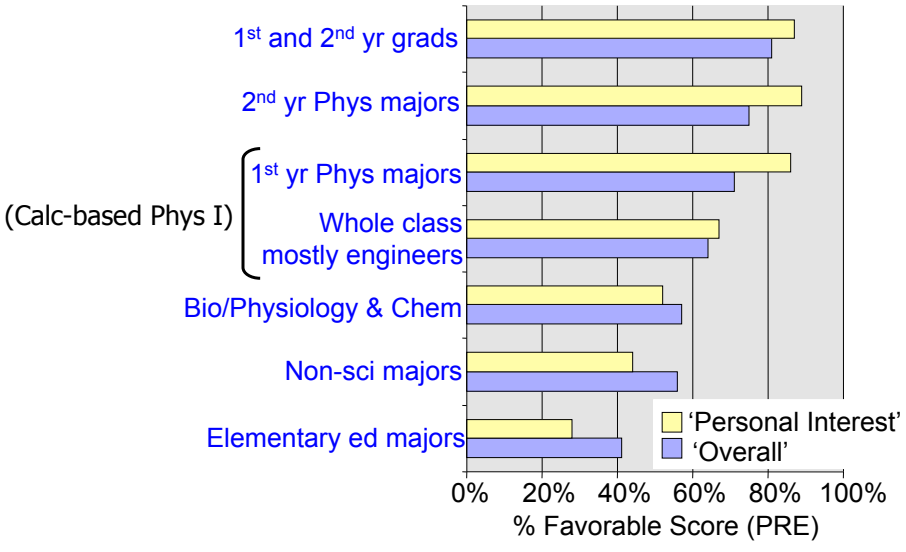
Dataset #2

TABLE 2. Correlations between beliefs (Overall and Personal Interest) and science course selection

	Course Type	School Type/Term	Dominant student population	No. of students w/ CLASS	Beliefs %favorable[$]			
					Overall		Personal Interest	
					Pre	Post	Pre	Post
Physics	Non-Sci-I	CU/Fa03	non-sci	77	56%	57%	44%	46%
	Non-Sci-II	CU/Sp04	non-sci	34	71%	73%	61%	67%
	Alg-I	CU/Fa04	pre-meds	313	56%	58%	49%	53%
	Calc-I (all)	CU/Sp04	engineers	416	64%	66%	72%	71%
	Calc-I (all)	CU/Fa04	engineers	400	64%	**58%**	67%	**56%**
	Calc-I (phys maj only)	CU/Fa04	phys maj	35	71%	69%	86%	82%
	Soph. Level Phys	CU/Sp05	phys maj	69	75%		89%	
Chemistry	Enviro.Chem	CU/Fa04	Env. and non-sci	79	50%	**44%**	49%	**35%**
	Gen.Chem-I (all)	CU/Fa04	bio/physiology	461	51%	**45%**	49%	**39%**
	Gen.Chem-I (chem. maj only)	CU/Fa04	chem. majors	45	54%	**50%**	62%	**49%**
	Honors Gen Chem-I	CU/Fa04	biochem/chem.	20	73%	**67%**	78%	75%
	Junior Level Chem	CU/Fa04	physical chem.	16	69%	**63%**	71%	68%

I=1st semester, II=2nd semester; [$] typical standard deviation for 'Overall' is ~16%. Uncertainties for the Personal interest range from ~1% for 400 students to ~5% for 16 students. Stat. significant shifts in color. See text.

Dataset #2b



Dataset #3

Student ABs by gender

TABLE 3. Comparison of mens' and womens' beliefs about science

		Physics Majors (Calc I–Fa04)		Engineers (Calc I–Sp04)		Engineers (Calc I–Fa04)		Biology Majors (Alg I–Fa04)	
Physics	Belief Category	Men	Women	Men	Women	Men	Women	Men	Women
	Personal Interest: Pre (Shift)	85 (-6)	89 (0)	73 (0)	67 (-5)	73 (-12	61 (-10	59 (+2)	38 (+10)
	Real World Conn.: Pre (Shift)	80 (+1)	89 (+6)	74 (+2)	64 (+4)	72 (-4)	64 (-2)	62 (+17	44 (+20)
	Prob. Solv. Confidence: Pre (Shift)	68 (+1)	86 (-16)	N/A	N/A	76 (-11	70 (-16	78 (-1)	61 (-2)
		Chem Majors (Honors Chem I)		**Chem Majors (Gen Chem I)**		**Engineers (Gen Chem I)**		**Biology Majors (Gen Chem I)**	
Chemistry	**Belief Category**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**
	Personal Interest: Pre (Shift)	83 (-10)	77 (-10)	65 (-8)	60 (-17	48 (-11	60 (-25	53 (-12)	50 (-11)
	Real World Conn.: Pre (Shift)	80 (-7)	77 (-10)	57 (+3)	58 (-10	45 (-5)	56 (-14	48 (-11)	44 (-3)
	Prob. Solv. Confidence: Pre (Shift)	80 (-10)	91 (-10)	60 (-1)	72 (-11	71 (-25	65 (-5)	57 (-7)	57 (-7)

Dataset #3b

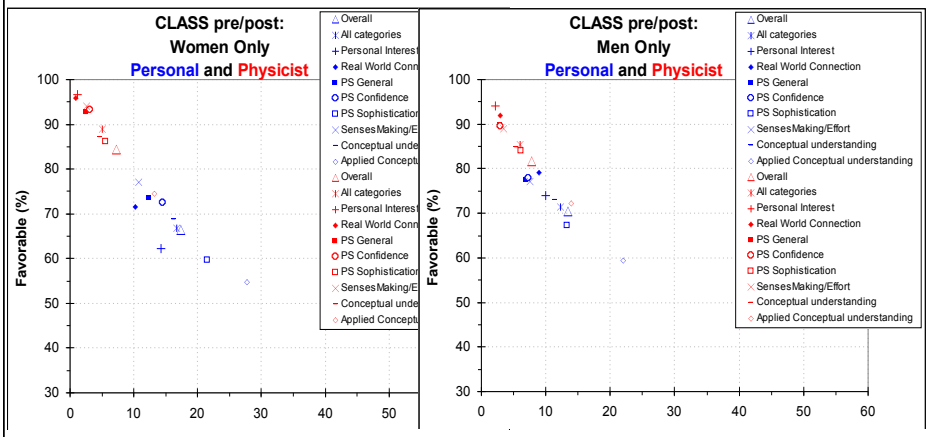
Gender Differences

		Men	Women
Physics Majors	Overall	63	55
Alg-based	Personal Interest	62	42
	Real World Connection	72	55
		(N=115)	(N=191)
	Overall	83	80
2nd year	Personal Interest	92	94
	Real World Connection	88	95
	Overall	82	88
3rd year	Personal Interest	89	100
	Real World Connection	89	100
	Overall	78	94
4th year	Personal Interest	82	94
	Real World Connection	77	92
		(N=130)	(N=18)

Dataset #4

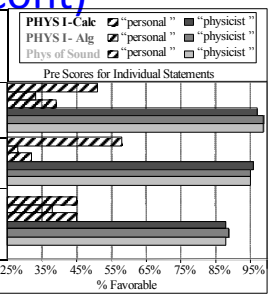
Students responded to CLASS survey in two ways:
PERSONAL = "What do you believe?"
PHYSICIST = "What would a physicist say?"

Calculus-based 1st term physics

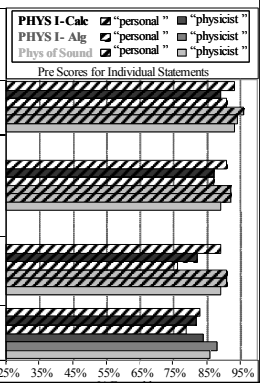


Dataset #4 (cont)

% of Students Who "Split"			Statements (expert response)
PHYS I-Calc	PHYS I-Alg	Phys of Sound	
48%	67%	60%	3. I think about the physics I experience in everyday life. (agree)
41%	67%	64%	25. I enjoy solving physics problems. (agree)
49%	56%	52%	36. There are times I solve a physics problem more than one way to help my understanding. (agree)



% of Students Who "Split"			Statement (expert response)
PHYS I-Calc	PHYS I-Alg	Phys of Sound	
5%	7%	8%	29. To learn physics, I only need to memorize solutions to sample problems (disagree)
8%	11%	12%	23. In doing a physics problem if my calculation gives a result very different from what I'd expect, I'd trust the calculation rather than going back through the problem. (disagree)
8%	14%	13%	26. In physics, mathematical formulas express meaningful relationships among measurable quantities. (agree)
11%	15%	13%	10. There is usually only one correct approach to solving a physics problem. (disagree)



Group Reporting

- Conceptual understanding
- Distribution and course
- Gender
- Personal-view vs "What a physicist thinks"

Goals:

Physics courses should focus more on epistemological development and less on content coverage .. Elby

I would enjoy talking more about the goals of physics classes

How do these messages get sent?

Homework Example from 121

Group Discussion about strategies

- What are strategies that you're aware of? Have read about?
- What are the challenges?

Elby's Approach

Elby makes it pretty clear that you have to have a "wholehearted" commitment to changing students' epistemological beliefs about physics. He also says that it would be possible to promote the same types of gains in college-level physics courses.

1. Epistemology lessons embedded into labs, problems, and class discussions
2. "Epistemology" homework and in-class problems
3 Effort-based homework grading, and solutions handed out with the assignment
4. Homework and test questions emphasizing explanation
5. Reduced use of traditional textbook
6. Fluid lesson plans
7. Radically reduced content coverage
8. Instructor commitment to epistemological development

Be a high school student.

- What physics questions do you have?

High School Challenge

- Can you apply your knowledge of momentum to make a Rube Goldberg